[redacted]

410942

DELETED VERSION ONLY

OPERATION REDWING

A PRELIMINARY REPORT

OF

[redacted] (ZUNI)

Submitted by Task Group 7.1

JO-269

15 October 1956

[redacted]

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CONTENTS

	PAGE NO.
INTRODUCTION	5
PART I - GENERAL INFORMATION	6
Observed Weather at Shot Time	7
Fig. 0-1 - Bikini Atoll Map	9
Fig. 0-2 - Scientific Stations and Zero Point	10
Fig. 0-3 - Pre-Shot Photo	11
Fig. 0-4 - Post-Shot Photo	12
Fig. 0-5 - RadSafe Survey, D-Day	13
Fig. 0-6 - RadSafe Survey, D + 1 Day	14
Fig. 0-7 - RadSafe Survey, D + 2 Day	15
PART II - DOD PROGRAMS	16
Project 1.1 - Basic Blast Measurements	17
Project 1.3 - Shock Photography	20
Project 1.5 - Drag Characteristics of Various Shapes	21
Project 1.8 - Crater Measurements	24
Project 1.9 - Water Wave Studies	27
Project 2.1 - Gamma Exposure vs Distance	29
Project 2.2 - Gamma Dose Rate vs Time	31
Project 2.4 - Decontamination and Protection	32
Project 2.61 - Rocket Determination of the Activity Distribution Within the Stabilized Cloud	36
Project 2.62 - Fallout Studies by Oceanography Methods	38
Project 2.63 - Collection and Characterization of Fallout With Time	40
Project 2.64 - Fallout Location and Delineation by Aerial Survey	43
Project 2.65 - Analysis of Fallout and of Base Surge	44
Project 2.66 - Early Cloud Penetration	48

4

[redacted]

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PAGE NO.

Project 2.71 - Relative Importance of the Various Radiation Sources to the Ship Shielding Problem. 50

Project 2.8 - Shipboard Countermeasures Methods Studies. 53

Project 2.9 - Standard Recovery Procedure for Tactical Decontamination of Ships 55

Project 2.10 - Verification of Washdown Effectiveness as a Shipboard Radiological Countermeasure. 57

Project 4.1 - Biomedical Effects - Flash Blindness and Chorioretinal Burns. 60

Project 5.1 - In-Flight Participation of a B-47. 63

Project 5.2 - In-Flight Participation of a B-52. 65

Project 5.3 - In-Flight Participation of a B-66B 67

Project 5.4 - In-Flight Participation of a B-57B 69

Project 5.5 - In-Flight Participation of F-84F Aircraft. 71

Project 5.7 - Thermal Flux and Albedo Measurements from Aircraft 72

Project 5.8 - In-Flight Participation of an A3D-1 Aircraft . . . 75

Project 6.1 - Accurate Location of Electromagnetic Pulse Source 77

Project 6.3 - Effects of Atomic Explosion on the Ionosphere. . . 79

Project 6.4 - Determination of Characteristics of Airborne Flush Mounted Antennas and Photo Tubes for Yield Determination at Extended Ground-to-Air Ranges . . 82

Project 6.5 - Analysis of Electromagnetic Pulse Produced by a Nuclear Explosion. 84

Project 8.1 - Basic Thermal Radiation Measurements 85

Project 8.5 - Airborne High Resolution Spectral Analysis 88

Project 9.1 - Technical Photography. 90

PART III - LASL PROGRAMS. 91

Project 16.3 - Electromagnetic Investigations 92

Project 18.3 - Spectroscopy 93

Project 18.4 - Chord Experiment - Time Interval Measurement . . . 94

[redacted]

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PAGE NO.

PART IV - UCRL PROGRAMS 99

Project 21.1 - Radiochemical Analysis 100

Project 21.2 - Sampling 101

Project 21.3 - Short Half-life Activities 102

Project 22.1 - Measurement of Alpha and Timing. 104

Project 23.1 - Fireball and Bhangmeter. 111

Project 23.2 - Cloud Photography. 114

Project 23.3 and 23.4 - Time Interval and Time and Pressure Measurements. 116

Project 23.5 - Remote Time Measurements 119

DISTRIBUTION. 120

[redacted]

[redacted]

[redacted] (ZUNI)

INTRODUCTION

[redacted] was a UCRL, Livermore, [redacted] nuclear device

DELETED

[redacted] was detonated as the Zuni shot on the ground at the west end of Eninman Island, Bikini Atoll, at 0556:00.3 on May 28, 1956, and appears to have operated very closely as predicted.

DELETED

[redacted]

[redacted]

PART I

GENERAL INFORMATION

Observed Weather at Shot Time

Fig. 0-1 - Bikini Atoll Map

Fig. 0-2 - Scientific Stations and Zero Point

Fig. 0-3 - Pre-Shot Photo

Fig. 0-4 - Post-Shot Photo

Fig. 0-5 - RadSafe Survey, D-Day

Fig. 0-6 - RadSafe Survey, D + 1

Fig. 0-7 - RadSafe Survey, D + 2

9

[redacted]

[redacted]

BIKINI OBSERVED WEATHER FOR 28 MAY 1956
ZUNI SHOT TIME 0556M

Sea Level Pressure	1010.5 mb
Temperature	81°F
Dew Point	76°F
Relative Humidity	80%
Surface Wind	090°, 12 kts
Visibility	8 Miles

<u>CLOUDS</u>

Surface Observation: (taken aboard USS ESTES)

2/10 Cumulus	2,000 ft
1/10 Altostratus	8,000 ft
5/10 Cirrostratus	35,000 ft

Aircraft Observation: (of Bikini Area)

	BASE	TOPS
3 to 4/10 Altocumulus and Altostratus	8,000 ft	12,000 ft
4 to 6/10 Altostratus	17,000 ft (Thin Layer)	
4/10 Cirrus	25,000 ft	27,000 ft
4 to 7/10 Cirrus and Cirrostratus	35,000 ft	40,000 ft

<u>WEATHER</u>

No shower activity observed either visually or by radar at shot time.

<u>STATE OF SEA</u>

Open sea; wave heights 6 feet; Period 6 seconds. Direction 070°.

Sea water temperature, 83°F.

9

[redacted]

[redacted]

Pressure Millibars	Height Feet	Temperature °C	Dew Point °C
1000	310	27.2	22.8
894	3,543	19.5	15.2
850	4,950	17.8	08.8
784	7,251	15.2	-04.5
773	7,644	14.2	00.2
738	8,924	12.5	-09.5
716	9,711	09.5	02.2
704	10,171	10.2	-14.5
700	10,340	09.8	M
618	13,747	05.5	-17.5
538	17,356	-04.2	-13.5
526	17,946	-04.8	-22.8
500	19,260	-07.0	-19.0
400	24,880	-17.5	-28.2
358	27,526	-22.2	-34.8
300	31,580	-32.8	-42.2
267	34,285	-38.8	-48.2
250	35,700	-42.7	M
200	40,510	-54.1	M
150	46,340	-69.8	M
116	51,214	-79.0	M
100	54,010	-80.4	M
94	55,151	-81.0	M

BIKINI WINDS ALOFT

Height Feet	Direction Degrees	Speed Knots	Height Feet	Direction Degrees	Speed Knots
1,000	080	23	20,000	140	10
2,000	070	22	22,000	140	12
3,000	070	24	24,000	160	15
4,000	090	24	26,000	170	18
5,000	090	21	28,000	160	14
6,000	100	19	30,000	170	12
7,000	100	19	32,000	210	27
8,000	100	19	34,000	220	21
9,000	100	19	36,000	230	29
10,000	100	20	38,000	230	38
12,000	090	21	40,000	220	40
14,000	090	15	45,000	210	35
16,000	110	10	50,000	240	25
18,000	100	10	51,000	250	25

10

[redacted]

[redacted]

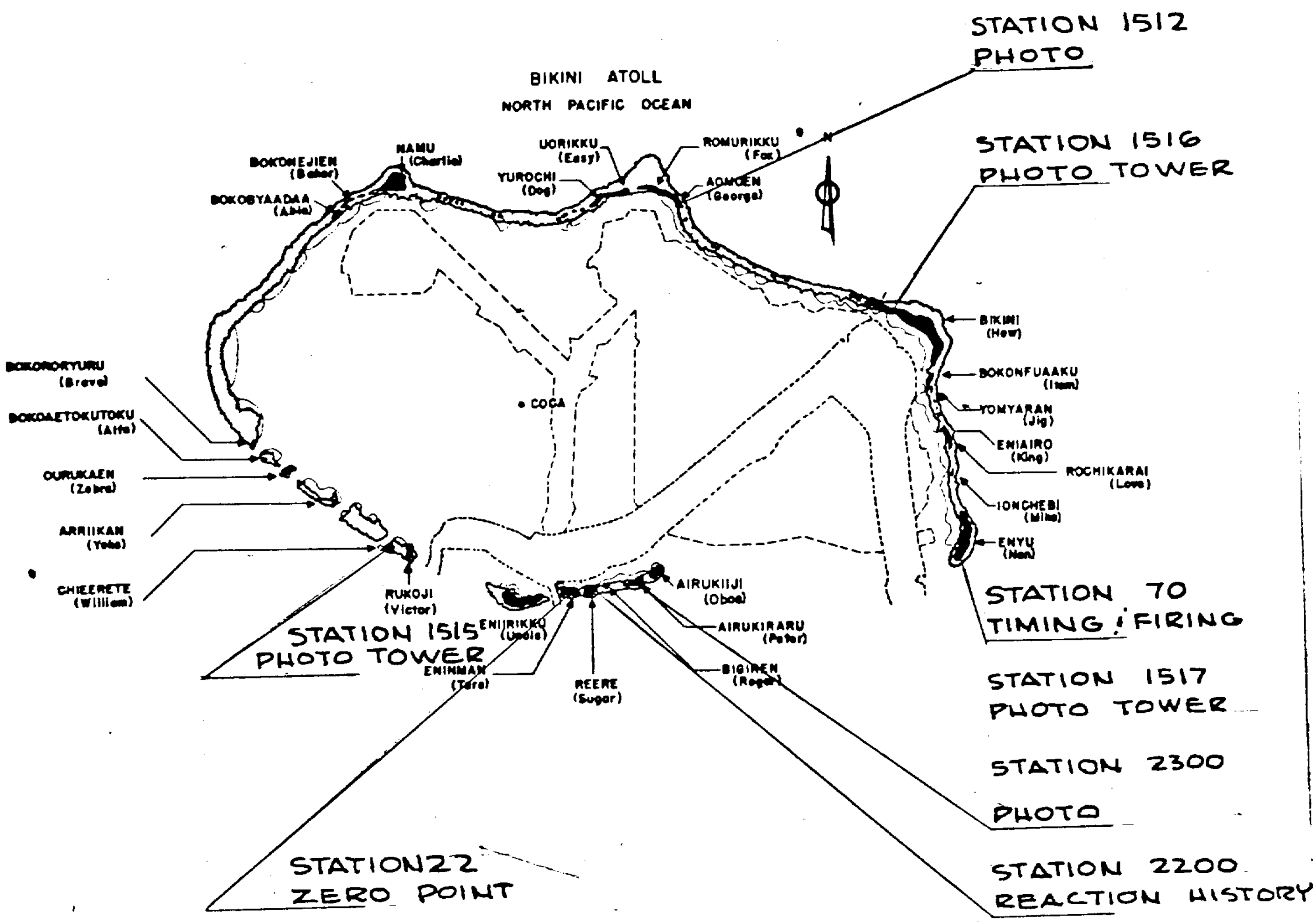

Fig. 0-1 - Bikini Atoll Map

[redacted]

[redacted]

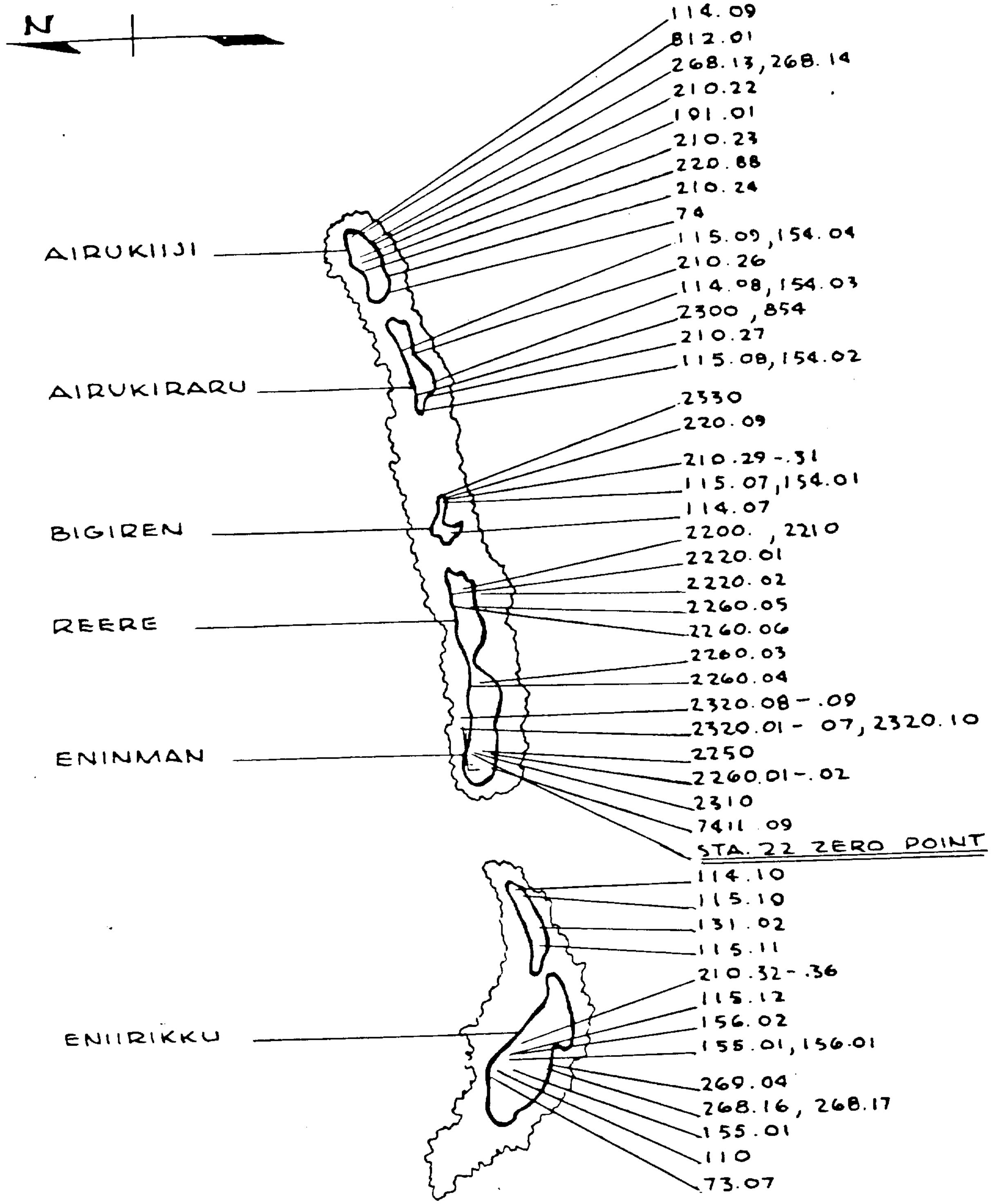

Fig. 0-2 - Scientific Stations and Zero Point

12

[redacted]

[redacted]

[redacted]

13

[redacted]

[redacted]

[redacted]

28 May 1956
Readings in mr/hr
Int/Alt/Time

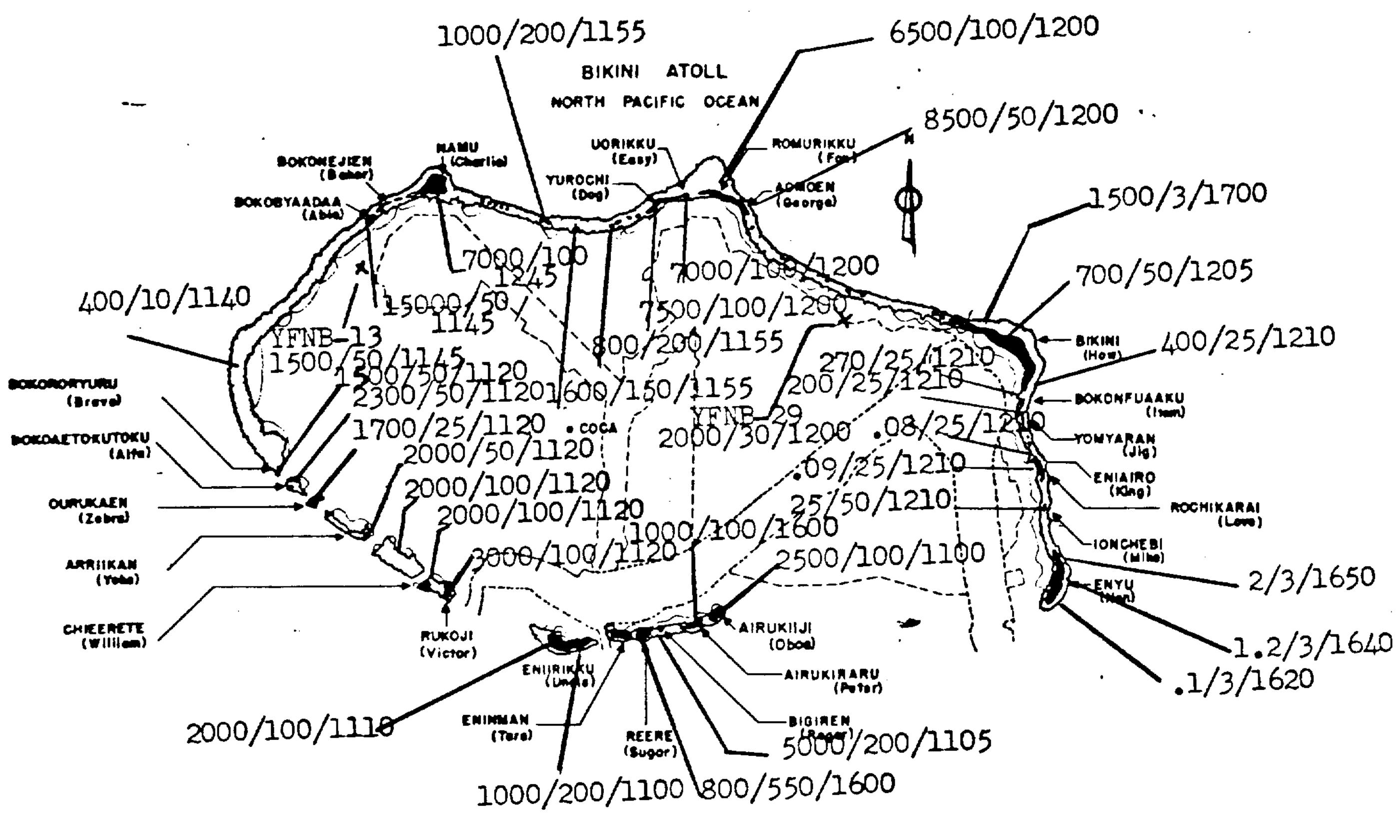

Fig. 0-5 - RadSafe Survey, D-Day

15

[redacted]

29 May 1956
Readings in mr/hr
Int/Alt/Time

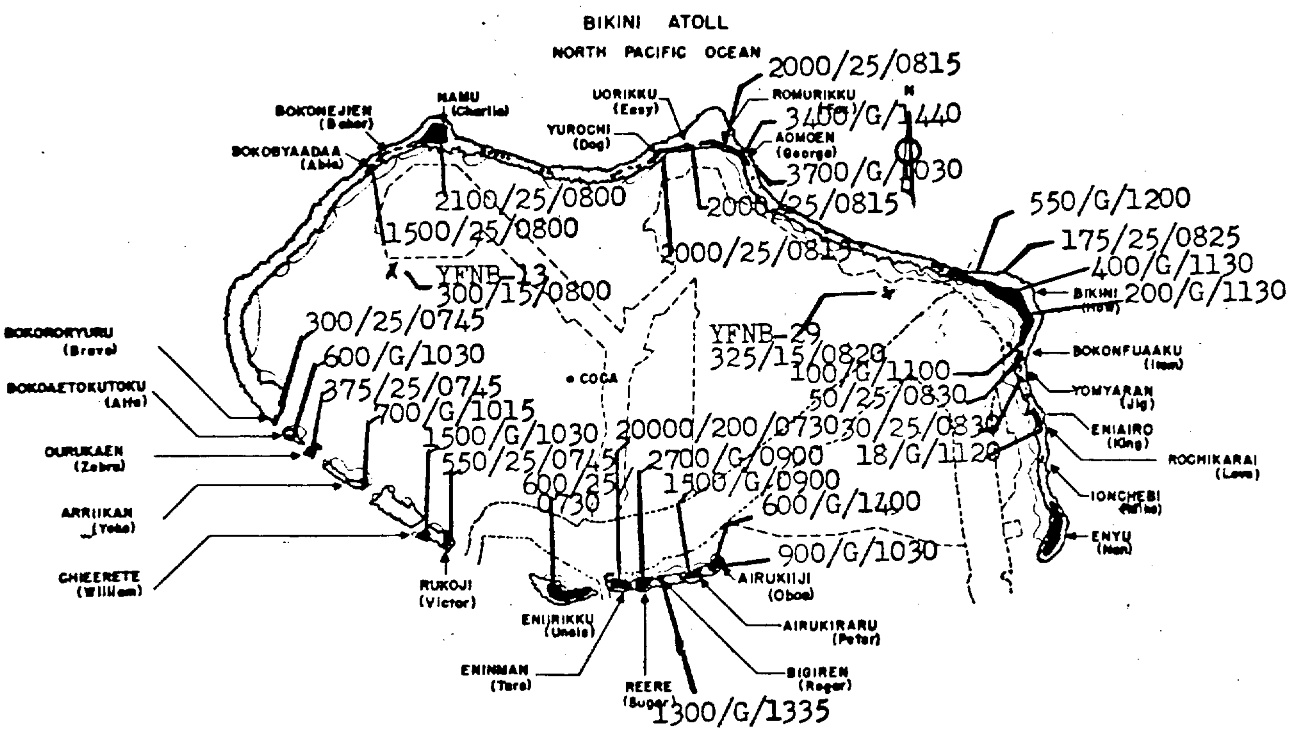

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Fig. 0-6 – RadSafe Survey, D + 1 Day

[redacted]

30 May 1956
Readings in mr/hr
on Ground at 1800 hrs

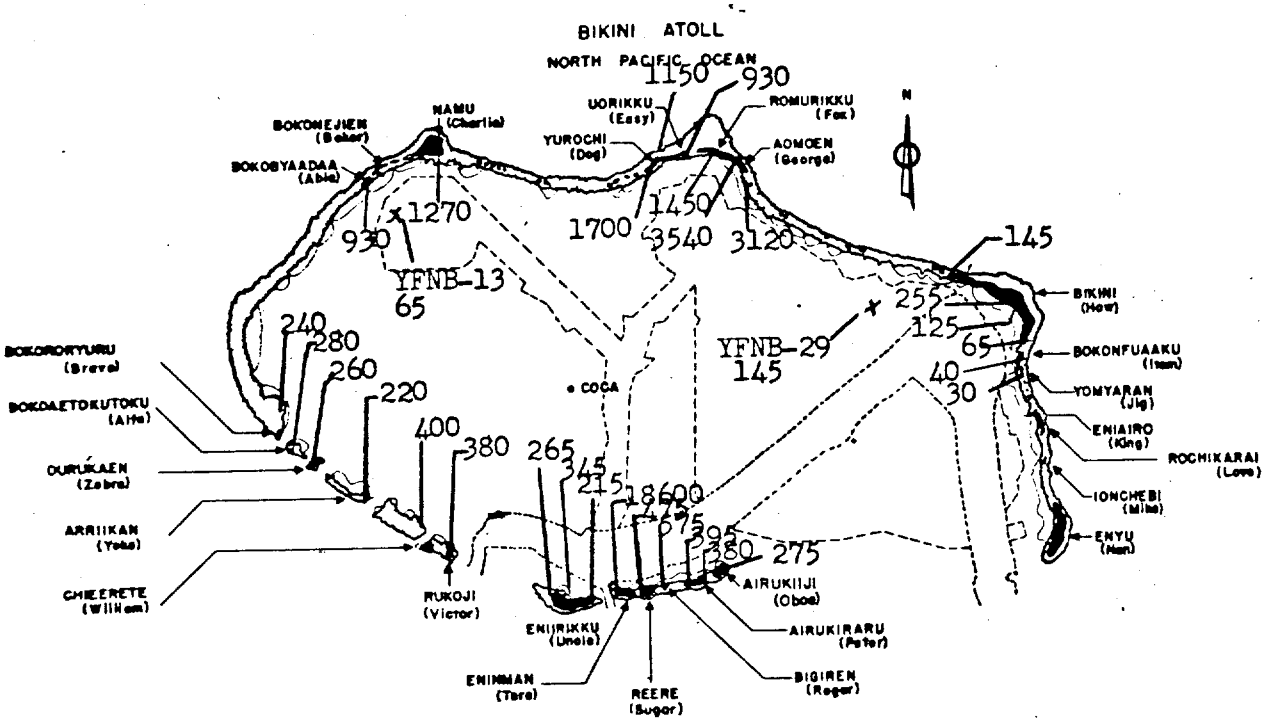

Fig. 0-7 - RadSafe Survey, D +.2 Day

[redacted]

PART II

TASK UNIT 3

DOD PROGRAMS

K. D. Coleman

Col. K. D. Coleman
CTU-3

Program 1 - Blast and Shock Measurements	Maj. H.T. Bingham
Program 2 - Nuclear Radiation and Effects	CDR D.C. Campbell
Program 4 - Biomedical Effects	Lt Col C.W. Bankes
Program 5 - Aircraft Structures	CDR M.R. Dahl
Program 6 - Tests of Service Equipment and Materials	Lt Col C.W. Bankes
Program 8 - Thermal Radiation and Effects	CDR A.H. Higgs Maj. W.C. Linton
Program 9 - General Support	Lt Col J.G. James

[redacted]

Project 1.1 - Basic Blast Measurements - J. J. Meszaros

The objective of the participation of Project 1.1 on the [redacted] (Zuni) was to document the propogation of a blast wave from a megaton yield surface burst.

A total of 25 pt gages and 9 q gages were installed for Zuni. Two blast lines were instrumented. There were 14 pt gages and 4 q gages on the Eninman Complex while on Eniirikku Island, 10 pt gages and 5 q gages. There was 1 pt gage on Enyu for Water Wave Studies.

There was considerable damage both to the pt and the q mounts. Three pt mounts were blown out and the gages were not recovered. Six of the q mounts suffered from severe to light damage. Two were blown out completely while the other four were bent back at various angles.

There was a precursor wave recorded on both blast lines. The recorded values of peak overpressure are plotted in Fig. 1.1-1. The values at the close in stations show a deviation from the pressure distance curve plotted from the pressure values predicted for a 3.5 MT yield for a poor surface. The pressure time records from both blast lines show distorted wave shapes similar to those associated with a precursor. Although the wave shape is distorted, the peak overpressure values beyond 8,000 feet follow the predicted pressure distance curve for a yield of 3.5 MT at zero height of burst over a poor surface. There is a wide spread between the pressure values recorded at 7020 feet on Eniirikku and 6900 feet on Eninman Complex. It is believed that this difference is real and not a gage error. If the data points from Eniirikku are connected a precursor type pressure-

[redacted]

distance curve is obtained.

A compressibility factor for Mach flow was applied to the dynamic pressure values from the Eninman Complex. The corrected values are plotted in Fig. 1.1-1. Along with the corrected values a curve is plotted using the calculated values from the equation:

$$Pd = \frac{2.5\ (Ps)^2}{7P_o + P_s}$$

Where P_s = Peak side-on overpressure
P_o = Atmospheric pressure

20

[redacted]

[redacted]

[redacted]

21

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Project 1.3 - Shock Photography - J. Petes

OBJECTIVES

To study the mechanical effects of a water surface on shock propagation.

To study the thermal effects, if any, resulting from heating of air near the ground surface on shock transmission.

To determine peak shock overpressure as a function of distance both at the surface (water) and above ground zero.

INSTRUMENTATION

The instrumentation for this shot consisted of smoke rocket photography.

Rockets were fired from a station on Eniirikku approximately 6000' from ground zero. The cameras were located on Enyu.

RESULTS

The rocket instrumentation and the photographic instrumentation were successful.

The films were of very high quality and can be used to obtain all three objectives.

The preliminary inspection of the films shows no thermal effects in the field of view of project films.

22

Project 1.5 - Drag Characteristics of Various Shapes - J. J. Meszaros

VEHICLE RESPONSE STUDY

OBJECTIVE

The vehicles were exposed on this shot to obtain information which would supplement data from Operation CASTLE. Due to weapon difficulties for one shot and lack of land area for the second shot, the data obtained on that operation were considered insufficient to make concrete conclusions. This was especially true for transition from light to severe damage levels.

TECHNIQUE

Ten vehicles (truck, $\frac{1}{4}$ ton, 4 x 4, utility, Model MB - WWII) were set up at six stations. One side-on vehicle was placed at 6900 feet from ground zero. Two vehicles were arranged at 8300, 10,400, 11,700 and 13,800 feet stations; one side-on and one face-on at each station. One vehicle was placed side-on at 16,500 feet. Steel stakes were driven in the ground at each station to facilitate displacement measurements.

RESULTS

Evaluation of the damage revealed very severe damage to all the vehicles at the 6900, 8300, 10,400, and 11,700 feet stations except the face-on vehicle at 11,700 feet. The four side-on vehicles and one face-on at 8300 feet were completely demolished. The face-on vehicle at 10,400 feet was intact except that the engine was thrown out. The face-on vehicle at 11,700 feet and side-on at 13,800 feet were moderately damaged. The face-on vehicle at 13,800 feet and side-on vehicle at 16,500 feet were lightly damaged. None of the vehicles were considered suitable for immediate combat usability.

Parts were strewn as far as 1000 feet from the original vehicle location for the demolished vehicles while the least displacement was 50 feet for the side-on vehicle at 16,500 feet.

The effect of the water wave was not clearly evident from the evaluation although it is felt that the water wave did contribute to displacement and damage. Preliminary studies of pressure records indicate no extreme water wave.

CONCLUSIONS

In general, the desired transition of damage levels was attained. A more thorough analysis will be made later.

Based on preliminary studies the damage agrees with predicted damage levels using the formula and curves found in TM-23-200.

DIFFRACTION STUDY

OBJECTIVES

In consequence of the failure of the [redacted] (Koon) Shot on Operation CASTLE, the 6 x 6 x 12 foot target structure used then at Eniirikku by Project 3.1 was reinstrumented for the [redacted] (Zuni) Shot of Operation REDWING. The objectives were to obtain, for moderate blast pressures, diffraction-pressure versus time curves at various points on the surface of the structure and to make comparisons of these with similar curves obtained on 1/36th scale models tested in a shock tube. Thus, prediction methods of diffraction loading could be extended to higher pressure levels.

INSTRUMENTATION

The target structure was located 9700 feet from ground zero and was fitted with nine flush-mounting, Wiancko Type 3PAD, variable

[redacted]

reluctance, pressure gages. The gage pressure ranges were assigned on the basis of an expected free-field over-pressure of 17.5 psi at the structure and on shock tube diffraction studies.

Two free-field stations were used to give pressure-time and q - time records.

RESULTS

The expected ideal blast wave incident on the target structure was not realized, but instead, a distorted 22 psi wave with a slow rising front was recorded. This precluded an attempt to compare the data with that from the shock tube, but the possibility for comparison with data obtained from the passage of a precursor wave over a full size cubicle on Operation TEAPOT still exists. Neither sufficient time nor means for analysis of these data are available at the Pacific Proving Ground.

[redacted]

25

Project 1.8 - Crater Measurements - F. E. Deeds

OBJECTIVES

The objective of this project is to obtain measurements of the physical characteristics (radius, depth and average profile) of the crater produced by the detonation of atomic weapons at the surface of the ground. It is a further objective of this project to correlate the data obtained with previous surface bursts at the Pacific Proving Grounds (PPG) and with the JANGLE surface shot at the Nevada Test Site.

INSTRUMENTATION OR TECHNIQUES

Preshot Survey: Rays extending from ground zero and 60 degrees apart were surveyed to a distance greater than any expected crater radius. In addition, uncontrolled stereoptic aerial photographs were taken of the shot area.

Postshot Survey: Aerial photographs were taken in order that the diameter of the crater could be measured by the use of stereoptic equipment. At H + 2½ only one pass was made at an altitude of 1350 feet. The photographs showed the water to be so murky that a clear picture of the crater was not obtained. A second mission was set for D + 4. Passes were made at altitudes of 3,000 and 1,500 feet. Lead line soundings were to be made of the crater area proceeding along the same rays that were surveyed prior to the shot.

RESULTS

On D + 6 lead line soundings were made of the crater area. Due to an error made on zeroing in Raydist equipment the LCM was positioned at an erroneous ground zero (approximately 100 feet due south of its true position) thus all rays run parallel to the one surveyed before

[redacted]

the shot.

Soudings indicate that the depth of the crater was 106 feet below the datum plane (6 inches below mean low water springs) at ground zero. A profile of a special sounding is shown in Fig. 1.8-1.

[redacted]

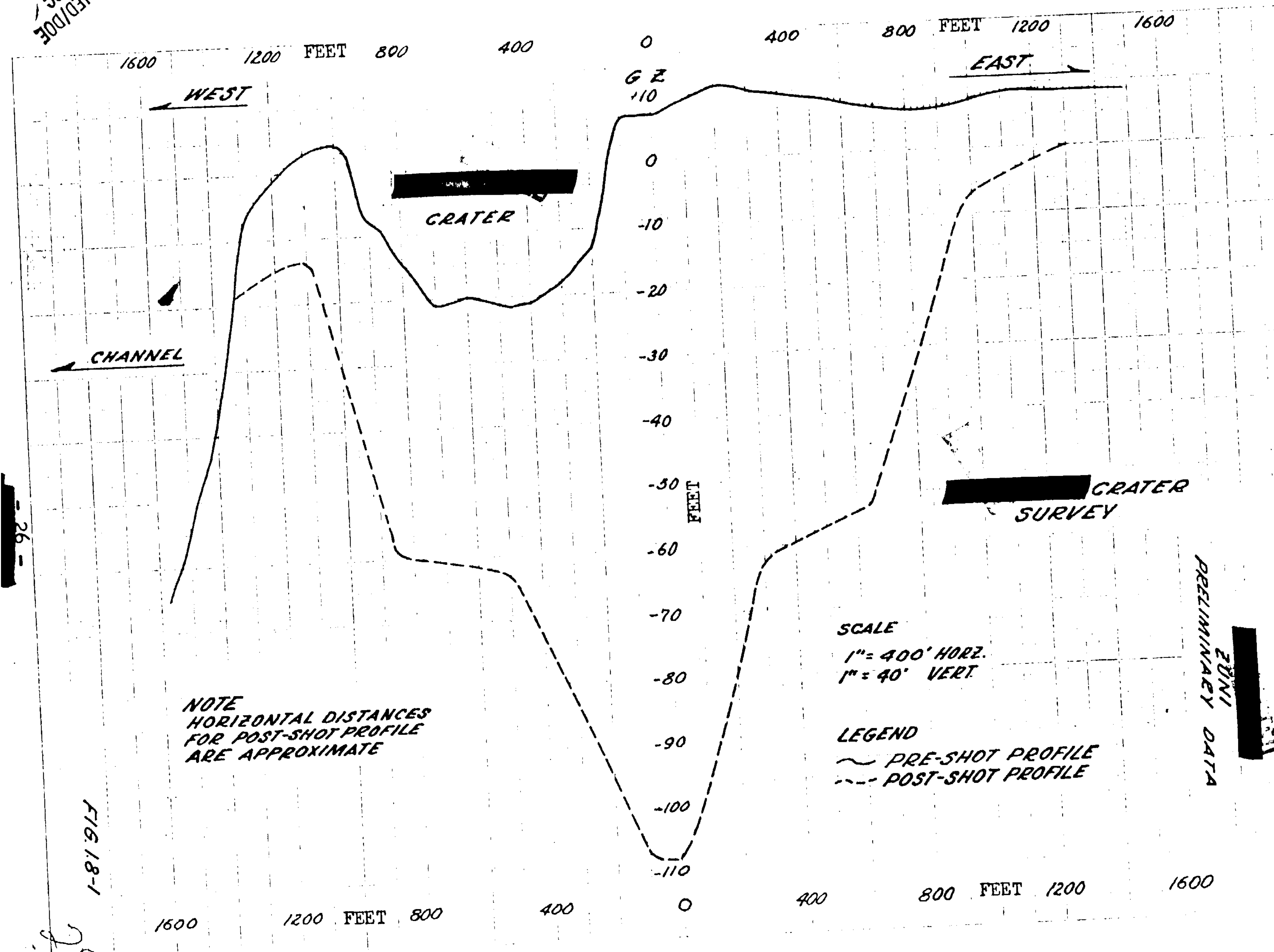
1600
1200
FEET
800
400
0
400
800
FEET
1200
1600
WEST
EAST
CHANNEL
G Z
+10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
FEET
[redacted]
CRATER
[redacted] CRATER
SURVEY
[redacted] ZUNI
PRELIMINARY DATA
SCALE
1" = 400' HORZ.
1" = 40' VERT.
LEGEND
~ PRE-SHOT PROFILE
--- POST-SHOT PROFILE
NOTE
HORIZONTAL DISTANCES
FOR POST-SHOT PROFILE
ARE APPROXIMATE
1600
1200
FEET
800
400
0
400
800
FEET
1200
1600

FIG. 1.8-1

28

[redacted]

[redacted] (ZUNI)

Project 1.9 - Water Wave Studies - L. W. Kidd

OBJECTIVE

Studies of water wave action generated by the detonation of large yield (greater than 1 MT) nuclear devices are made at relatively close ranges and at several distant islands by Project 1.9.

INSTRUMENTATION

The instrumentation on [redacted] (ZUNI) was essentially the same as for [redacted] (CHEROKEE), with the exception that higher local wave action in the Bikini area was expected, and a more extensive instrumentation effort was made in this area. Of the local instrumentation, five shore recording Mark VIII wave units (one at Eniwetok) and one skiff station in Bikini Lagoon gave useful data. BRL Project 1.1 made a number of inundation measurements, but the results are not available. An inundation survey has been completed at Bikini. Long period recorders as described in the [redacted] (CHEROKEE) report were in use at the distant stations.

RESULTS

The more distant long period stations gave results similar to the [redacted] (CHEROKEE). These are as follows:

Station	Approximate Range (mi)	Largest Wave Height (cm)	Period (sec)	No. of Waves
Ailinginae	40	Record not yet available		
Eniwetok	200	8.2	330	5
Wake	500	5	350	5 - 7
Johnston	1500	Undetectable above high background		

The very long period low amplitude waves were again observed on the Eniwetok record. Microbarographic records were obtained on Wake,

[redacted]

[redacted]

but instrument failure occurred on Johnston before disturbance arrival. It will be noted that the [redacted] produced waves as high as CASTLE [redacted] (Romeo), a 10 MT surface burst. This is again attributed to increased instrument sensitivity. The [redacted] results confirm the indications that the water wave disturbances are generated by barometric rather than direct energy coupling effects.

<u>Close in results are as follows:</u>

Wave action in the Bikini Lagoon was less than that expected. Approximate maximum deep water amplitude (trough to crest) at various stations were as follows:

Enyu	- 3½ feet
Bikini	- 2¼ feet
Airukiiji	- 6 feet
Chieerete	- 3½ feet

Periods of the [redacted] water wave train ranged from four minutes to one minute. Up rush and inundation on Bikini Atoll islands was insignificant except in the Eninman-Airukiiji complex and Eniirikku Island. The beach lines of this area show heavy scouring. The near half of Eniirikku was subjected to heavy wave action. The extremity of water inundation in the other direction was approximately the center of Airukiiji. Apparently there was unexpectedly great convergence and dissipation on the nearby islands near Eninman. In addition the crater broke through neither into the deep ocean nor the deep channel. All shore recording stations in the Bikini area yielded data on the overpressure.

[redacted]

Project 2.1 - Gamma Exposure vs Distance - P. Brown

OBJECTIVE

The object was to measure initial and residual gamma radiation using NBS type film badges, quartz fiber dosimeters, and chemical dosimeters.

DESCRIPTION AND EXPERIMENTAL PROCEDURES

Standard film badges and quartz fiber dosimeters were distributed at various positions throughout Bikini Atoll and on the ship stationed in the predicted fallout area. Some badges were exposed without interruption, while others were exposed in sequence or shielded from the fallout by dropping mechanisms activated after blast arrival.

RESULTS

Since all of the results are total exposures it was necessary to estimate the amount of residual in order to evaluate the initial gamma exposure. The estimates were based on known residual exposures at similar stations just outside the range of initial exposure and on relative recovery times and recovery rates. The estimated residual contamination was 150 roentgens for the land stations and 15 roentgens for the reef stations from Airukiiji through Eniirikku. Since individual residual exposure values may fluctuate, the value of initial data from a few of the stations is questionable. However, a curve based on all of the data should be of value. Table 2.1-1 gives the initial results.

CONCLUSIONS

The initial gamma exposure results are in reasonable agreement with predictions contained in TM 23-200.

3

[redacted]

TABLE 2.1-1 INITIAL GAMMA EXPOSURE RESULTS FROM [redacted] (ZUNI)

Station Number	Distance (feet)	Total Exposure (r)	Estimated Residual Exposure (r)	Resultant Initial Exposure (r)	Location
210.30	7,000	16,000	150	15,850	Bigiren
210.33	9,420	1,800	15	1,785	Eniirikku Reef
210.33	9,420	850	15	835	Eniirikku Reef
210.34	10,320	465	150	315	Eniirikku
210.35	10,935	205	15	190	Eniirikku Reef
210.27	11,270	200	150	50	Airukiraru
210.27	11,270	145	100	45	Airukiraru
210.56	11,510	69	15	54	Airukiraru Reef
210.26	12,940	25	15	10	Airukiraru Reef

[redacted]

[redacted]

[redacted] (ZUNI)

Project 2.2 - Gamma Dose Rate vs Time - P. Brown

OBJECTIVE

To measure residual gamma radiation intensity as a function of time at land fallout stations, and to measure the initial gamma intensity vs time for a high yield air burst.

INSTRUMENTATION

The initial gamma dose rate vs time was to be detected by scintillator-photomultiplier detectors with time response to 10 msec. Residual and fallout gamma intensity vs time was to be measured with ionization chambers and associated electronics. Station locations spread from Bokobyaadaa (Able) through Namu (Charlie) to Enyu (Nan), and on the YAG's and LST 611.

RESULTS

Essentially complete fallout data were obtained and it is believed that good initial gamma data were obtained. Evaluation of the results is in process, but no data can be recorded at present.

[redacted]

[redacted]

[redacted] (ZUNI)

Project 2.4 - Decontamination and Protection - J. C. Maloney

OBJECTIVES

To study the contamination of various types of building surfaces exposed at various orientations to the fallout.

To study the effectiveness of various decontamination procedures, and thus obtain data on the radiological recovery of military installations constructed from the tested types of material.

INSTRUMENTATION

Instrumentation was similar to that on the [redacted] (CHEROKEE) except:

Due to the difficulty in manipulating the canvas covers protecting the panels on the two structures, it was decided to forego the postshot surface covering.

Due to inadequate fallout on the YAG-39 from [redacted] (Zuni), the panels were not removed from this ship or decontaminated.

No radiochemical work is planned for the [redacted] Shot.

RESULTS

The following pages list the experimental results obtained so far. Numerical zero in the table means that the particular reading was so low (less than 7 mr/hr) that the statistical error was too large to give a meaningful result. All of the panels are from the YAG-40.

Residual percentages shown in this table are based on panel contamination levels as measured in the project area. Investigations will be made to determine the amount of original fallout contamination which was washed or blown off the panels before they were taken off the YAG-40.

[redacted]

[redacted]

It must be pointed out that the given data are of a gross character and are not to be interpreted as being final results for the [redacted] (Zuni) Shot.

[redacted]

[redacted]

TABLE 2.4-1

PERCENTAGE OF READING BEFORE DECONTAMINATION

Panel Surface	Surface Finish	Reading Before Decontamination (mr/hr)	Low Pressure Hose	Fire Pressure Hose	Water Scrub	Tide Scrub	Versene & Igopol Scrub
Asbestos Cement Shingles	Control & Silicone	80	57	38	44	42	42
	Multiple Pigment Paint	33	76	42	49	45	45
	Control & Silicone	15	80	100	58	0*	0*
	Control & Silicone	28	62	49	36	0	0
Wood Siding (Clapboard)	Control	35	62	55	25	0	0
	Lead & Oil Paint	19	86	72	38	0	0
	Multiple Pigment Paint	21	57	39	21	0	0
	Alkyd Resin Paint	19	80	72	38	0	0
	Control	12	73	34	24	0	0
	Lead & Oil Paint	24	68	51	18	0	0
	Multiple Pigment Paint	17	77	56	60	0	0
	Alkyd Resin Paint	21	73	59	42	0	0
	Control	55	48	37	26	20	0
	Lead & Oil Paint	23	76	60	44	0	0
	Multiple Pigment Paint	25	70	55	17	0	0
	Alkyd Resin Paint	14	70	59	0*	0	0
	Alkyd Resin Paint	9	97	61	49	0	0
Sheet Metal	Control & Epon Resin Paint	12	55	57	36	0	0
	Alkyd Resin Paint	13	76	63	67	0	0
	Alkyd Resin Paint	11	79	50	0	0	0
	Control	33	89	83	70	56	56
Brick (Medium Density)	Resin Emulsion Paint	26	92	84	67	50	50
	Control	7	0*	0*	0	0	0
	Control	75	100	68	62	54	54
Concrete Block	Control	50	85	71	64	55	55
	Resin Emulsion Paint	28	90	69	57	46	46
	Resin Emulsion Paint	4	0	0	0	0	0
	Resin Emulsion Paint	20	87	69	58	0	0

* 0 indicates reading at background level.

[redacted]

TABLE 2.4-1

PERCENTAGE OF READING BEFORE DECONTAMINATION (Cont'd)

Panel Surface	Surface Finish	Reading Before Decontamination (mr/hr)	Low Pressure Hose	Fire Pressure Hose	Water Scrub	Tide Scrub	Versene & Igopol Scrub
Poured Concrete (Smooth Finish)	Control	32	85	69	55	40	40
	Cement Water Paint	19	92	87	61	49	49
	Control	2	0	0	0	0	0
	Control	22	84	69	60	0	0
Stucco (Course Finish)	Resin Emulsion	29	87	66	60	57	57
	Resin Emulsion	5	0*	0*	0*	0*	0*
	Resin Emulsion	23	81	60	51	0	0
Special Phenolic	Phenolic Overlay Board & Phenloic Plywood	30	80	55	53	0	0
Concrete Pavement	Control	63	42	30	23	0	0
	Silicone	43	58	48	27	0	0
Asphalt & Gravel Built-up Roofing	Control	215	53	38	27	18	15
	Polyvinyl Alcohol	495	76	52	44	38	36
	Control	180	67	44	29	19	17
	Polyvinal Alcohol	315	74	50	40	36	34
Roll Roofing (Smooth Surface)	Control	42	60	59	21	0	0
	Polyvinal Alcohol	51	49	43	17	0	0
	Control	72	44	38	18	0	0
	Polyvinal Alcohol	49	42	34	20	0	0
Corrugated Metal Roofing	Control	38	60	58	7	0	0
	Asphalt Protected	71	51	42	10	0	0
	Control	34	64	60	26	0	0
	Asphalt Protected	42	55	46	17	0	0
Strip Shingle Roofing (Mineral Surface)	Control	165	70	44	44	35	26
	Control	175	72	52	42	32	24

* 0 indicates reading at background level.

[redacted]

[redacted]

[redacted] (ZUNI)

Project 2.61 - Rocket Determination of the Activity Distribution Within the Stabilized Cloud - R. Soule

OBJECTIVES

To determine the spatial distribution of radioactivity in the cloud of high yield thermonuclear detonations at two early times. The following special objectives are sought:

Relative activity distribution between stem and cloud.

Rate of change of activity at early times.

Performance of atmospheric sounding vehicles (ASP) up to high altitudes in an atomic cloud, and particularly whether information can be telemetered out of the radioactive cloud.

DESCRIPTION AND EXPERIMENTAL PROCEDURE

The radioactivity in the cloud was detected by pressure ion chambers borne by rocket propelled atmospheric sounding vehicles. The data was telemetered back to essentially duplicate receiving-recording stations on Enyu (Nan) and aboard the USS KNUDSEN.

Six rockets each were fired in two salvos at 5 minutes and 15 minutes after detonation. Various trajectories were selected by preshot aiming of the launchers. Highest altitude achieved was about 160,000 ft.

RESULTS

All rockets fired and good signal strength was received on all channels. The radiation fields that were measured, while of relatively high intensity, were lower than those encountered in [redacted] (CHEROKEE). Channels corresponding to rockets shot at the lowest elevation had no data on the carrier indicating they may have missed the

[redacted]

stem. Failure of automatic readout equipment prior to the first test will necessitate manual readout of the tapes.

Project 2.62 - Fallout Studies by Oceanography Methods - F. D. Jennings

OBJECTIVES

To understand the oceanography of the ocean area where fallout is expected in order to extrapolate the observed fallout pattern back to the equivalent land pattern. To furnish oceanographic assistance to the Task Force.

To measure the fallout radioactivity and its chemical nature in the water from a high air burst, a surface land burst, and surface water bursts. To calculate the equivalent land fallout pattern.

To understand the nature of the transport and dilution of radioactive fallout material in the ocean to permit future surveys to acquire a complete fallout picture from the least possible measurements.

To understand the oceanography of Bikini Lagoon as it involves the circulation of contaminated waters, particularly the effluent thereof and the occurrence of rapid transients of circulation which may result in sudden redistribution of activity.

DESCRIPTION AND EXPERIMENTAL PROCEDURE

The Bikini Lagoon was investigated using an instrumented trailer aboard a Navy LCU.

The project installed and maintained sixteen deep-moored skiff stations in the fallout area between 10 and 30 miles from ground zero. Recording instruments were installed on these skiffs to measure the radioactivity as a function of time at depth intervals of 20 meters down to 100 meters. A time of arrival starting pulse was supplied by Project 2.63.

Two high speed vessels were outfitted with devices for measuring radioactivity as a function of depth and in the air. These two vessels were stationed outside the fallout area during the shot and then proceeded to survey the fallout area making measurements out to about 300 miles from GZ. Approximately twenty-five surface samples and a number of samples from depths were taken for Project 2.63.

RESULTS

The postshot fallout survey, both in open ocean and within the Bikini Lagoon delineated and sampled radioactive areas. The results are in process of evaluation.

The three recording instruments on the deep moored skiffs were all outside the fallout area. Approximately half of the skiffs were in the fallout area.

[redacted]

DELETED

[redacted] ZUNI)

Project 2.63 - Collection and Characterization of Fallout with Time - T. Triffet

OBJECTIVES

To collect samples of fallout and measure radiation field intensities with time at various distances from high yield land, water and air thermonuclear detonations. To study these samples from early times with respect to gamma and beta activity, to analyze them for chemical and radiochemical composition and to determine certain of their physical properties, including distributions of particle sizes.

INSTRUMENTATION

DELETED

Instrumentation was similar to that used on [redacted] Shot (CHEROKEE), YAG-40 was located approximately 55 miles, YAG-39 approximately 95 miles, and LST-611 approximately 145 miles from ground zero.

RESULTS

Approximately 92 percent of all project instrumentation functioned properly and no significant damage to any station from blast or thermal effects was reported. All island, barge and raft stations received relatively heavy fallout, although radiation levels were not excessively high; and skiffs AA, BB, CC, DD, GG, HH, and MM also collected samples of moderate activity. Surface readings of samples collected on island, raft and barge stations averaged 400 mr/hr at 1300 on Z ≠ 1, with some as high as 2 r/hr; times of arrival in the immediate atoll area varied from about 14 minutes at the rafts to about 28 minutes at Aomoen and Bikini Islands. Prior to this event one Incremental Collector on the YFNB 29 was set for a two minute cycle, all others being set for 15 minutes; thus, since each of these instruments operated as planned,

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[redacted]

good definition both of the fallout front and of the total fallout was obtained.

With the exception of the probe and monitor mounted on the boom of the YAG-40 all instruments aboard the three project ships were operated during the fallout period. The YAG-40 occupied a position close to the estabilished line of maximum fallout and received a large quantity of fallout material (TOA = $H \neq 3\frac{1}{2}$, approximately); peak observed intensity on the deck, however, was only about 9r/hr ($H \neq 7$). Samples were obtained by the Special Incremental Collector until well beyond peak activity and all laboratory studies planned for early times (activity measurements, physical observations, decays and gamma spectra) were performed; these data are currently being reduced and will be reported when available. It is clear, however, that they will suffice for a comparatively detailed characterization of the fallout at this location. The YAG-39 also occupied a position on the established line of maximum fallout, but for reasons not clearly understood, received only a relatively light fallout (TOA = $H \neq 12\frac{1}{2}$, approximately); the intensity on the deck did not exceed 40 mr/hr ($H \neq 26$). The readings of all instruments were consistent, however, and good definition of the fallout at that point was obtained. It was, for example, observed that after the first peak was reached, normal decay did not occur; instead the activity built up to a second peak, then began to decay, indicating a second arrival of primary fallout. It was later established that the wind structure had collapsed during this period, and it is believed that the data obtained on this vessel may enable an eventual analysis of the behavior of fallout under such conditions. Due to the collapse of the winds prior to the expected time of arrival of fall-

[redacted]

out at the location occupied by the LST-611, no activity above background was observed on this vessel. The position was occupied well beyond the probable fallout period, however, in order to establish a positive limit in the changing situation described above.

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[redacted]

[redacted] (ZUNI)

Project 2.64 - Fallout Location and Delineation by Aerial Survey - R. Graveson

OBJECTIVES

To survey the gamma radiation from fallout contaminated ocean areas using an aircraft borne detector. To make air absorption measurements to correlate the aircraft data with the intensities measured at the surface of the sea.

INSTRUMENTATION

Three P2V-5 aircraft were equipped with gamma radiation detectors to record the dose rate arriving through the thin aircraft skin from a water surface below.

RESULTS

Flights were accomplished on D, D ≠ 1, D ≠ 2 and D ≠ 3 days with one aircraft.

The area north of Bikini Atoll from 315° to 45° T to a distance of about 175 miles was covered by the surveys. The contaminated area extended north of Bikini approximately 125 miles between the bearings 340° and 30° T.

The aircraft Program 2 Control Center telemeter system did not operate.

The radiation detector system operated and on D ≠ 1 through D ≠ 3 the intensity measured at the aircraft was relayed to the Program 2 Plot Center via voice radio. With this data it was possible to construct a plot showing roughly the characteristics of the contaminated area.

45

[redacted] (ZUNI)

Project 2.65 - Analysis of Fallout and of Base Surge - M. Morgenthau

OBJECTIVES

The general objectives of project 2.65 participation in REDWING were to: Obtain fallout samples on land and to perform radiophysical and radiochemical measurements on the samples; prepare dose rate contours of the atoll area from information gathered by this project, other projects, and Rad Safe; and evaluate the role of the base surge in transport of radioactive material.

DESCRIPTION AND EXPERIMENTAL PROCEDURES

Instrumentation was similar to that used for [redacted] (CHEROKEE).

On D-day, D ≠ 1, and D ≠ 2 an aerial survey of residual radiation was made over the atoll by helicopter. The measurements were taken by means of a probe on a long cable suspended below the hovering helicopter.

Base surge detectors were installed on three Bikini stations to record the arrival of the base surge. These detectors collected information to be used in conjunction with Project 2.2 gamma versus time data and IFC data to evaluate the role of base surge as a carrier of radioactivity. Radiochemical analysis will be performed on the IFC samples in an attempt to establish whether the base surge is a contaminating event independent of the fallout.

RESULTS

Aerial survey data for the [redacted] are shown in Table 2.65-1. The field readings were corrected for meter calibration and readings

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[redacted]

taken on three successive days were plotted as a function of time for seven representative islands. The field gamma decay exponents so determined are shown below:

Island	Decay Exponent
Acmoen	-0.94
Yurochi	-0.94
Bokobyaadaa	-1.0
Bokororyuru	-1.05
Bikini	-0.93
Ourukaen	-0.9
Chieercte	-1.05

The average exponent for the period H + 8 hours to H + 50 hours is -0.97.

Typical beta decay and gamma dose rate decay curves were prepared. These curves cover the period H + 60 to H + 50 hours. Measurements will continue to be made until H + 1000 hours.

Analysis of intermittent fallout collector data, particle size data, and radiochemical data is in progress. A significant portion of this information should be available in time for inclusion in the preliminary report at the end of the operation.

[redacted]

[redacted]

TABLE 2.65-1

CORRECTED AERIAL SURVEY READINGS - [redacted] (ZUNI) (DECAY FACTOR: -1.0)

Island	Day	Time (hrs)	Corrected Reading (mr/hr)	Average Dose Rates (r/hr) H + 1 hr	H + 12 hr
Bokobyaadaa	Z Z + 1 Z + 2	1451 1528 1434	12000 3100 1900	106	9
Namu [redacted]	Z + 1 Z + 2	1521 1421	4000 2200	129	11
Namu (NE)	Z Z + 1 Z + 2	1441 1524 1430	11000 3700 2000	111	9
Yurochi	Z Z + 1 Z + 2	1431 1515 1414	13000 4000 2300	124	10
Romurikku	Z Z + 1 Z + 2	1427 1510 1415	13000 4300 2400	130	11
Aomoen	Z Z + 1 Z + 2	1421 1506 1413	12000 3700 2300	118	10
Bikini (center)	Z Z + 1 Z + 2	1411 1458 1405	1400 470 280	11	0.91
Bikini (south tip)	Z Z + 1 Z + 2	1407 1455 1403	700 290 120	7.3	0.61
Rochikarai	Z Z + 1 Z + 2	1402 1440 1359	130 50 40	1.64	0.136
Airukiraru	Z Z + 1 Z + 2	1531 1600 1502	2500 1500 870	50	4.15
Enirikku (west end)	Z Z + 1 Z + 2	1523 1553 1456	1100 930 620	34	2.83

48

[redacted]

TABLE 2.65-1

CORRECTED AERIAL SURVEY READINGS - [redacted] (ZUNI) (DECAY FACTOR: -1.0)Cont'd

Island	Day	Time (hrs)	Corrected Reading (mr/hr)	Average Dose Rates (r/hr) H + 1 hr	Average Dose Rates (r/hr) H + 12 hr
Chieerete	Z	1516	870	53	4.4
	Z + 1	1548	1600		
	Z + 2	1451	920		
Ourukaen	Z	1508	2700	28	2.3
	Z + 1	1542	870		
	Z + 2	1445	500		
Bokororyuru	Z	1502	3100	29	2.4
	Z + 1	1538	820		
	Z + 2	1443	530		

[redacted]

DELETED

[redacted] ZUNI)

Project 2.66 - Early Cloud Penetration - Col F. A. Pinson

OBJECTIVES

To collect and evaluate data relating to radiation dose rate vs time in radioactive clouds from thermonuclear weapons.

To measure and evaluate the radiation hazards associated with the residual contamination on aircraft which have flown through thermonuclear clouds at early times after detonation.

To measure the turbulence in a thermonuclear cloud at early times after detonation.

Radiation dose rate inside the cloud vs time after detonation.

The extent and quality of the residual contamination on the aircraft after landing.

INSTRUMENTATION OR TECHNIQUES

DELETED

Instrumentation was the same as for [redacted] (CHEROKEE). [redacted] DELETED [redacted] penetrations were made at H ≠ 52, 68, and 78 minutes at altitudes varying from 38,000 feet to 46,000 feet. These penetrations were all "Nip" penetrations in which the pilot flies into the cloud, makes a 180 degree turn and flies out of the cloud. The time in the radioactive cloud varied from 2 to 4 minutes.

RESULTS

The dose rates in the cloud and the total dose received on the mission were as predicted or below.

The average dose rates in the cloud [redacted] were 30, 32, and 37 r/hr respectively. The total doses received by the pilots were 1215,

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[redacted]

[redacted]

1530, and 2125 mr. The dose received on the return flights of approximately 60 minutes duration was 25 to 33 percent of the total dose received on the mission. No turbulence was experienced.

[redacted]

[redacted]

[redacted] (ZUNI)

Project 2.71 - Relative Importance of the Various Radiation Sources to the Ship Shielding Problem - H. R. Rinnert

OBJECTIVES

To determine the relative radiation dose rates contributed by contamination of the air envelope, water envelope, and the ship's weather surfaces.

To determine the time dependent gamma ray combined absorption and scattering coefficients of steel to be used in future calculations of shielding effectiveness.

To field test new and improved detector systems.

To obtain gamma radiation measurements at various points on and in the ship as a function of time for the following purposes:

Check points for future shielding calculations.

Determination of the radiological situation at various locations aboard ship for Projects 2.63 and 2.10, to be used for operational control of the test ships.

INSTRUMENTATION

YAG-40 received enough contamination to supply data to satisfy all objectives. Only YAG-40 data have been reduced to date. The instrumentation performed satisfactorily.

RESULTS

Relative Gamma Radiation Fields Contributed by Various Radiation Sources

"Free field" measurements were compared, these free fields are defined as follows: Water free field - 4 pi radiation field at a water depth of between 20 and 30 feet; Air free field - 2 pi radiation field

[redacted]

on the ship's deck resulting from contaminants in the air surrounding the ship; and Residual free field - the radiation field on the ship's deck resulting from contaminants on the ship's weather surfaces.

The relative contributions by the various sources were compared both in a region which was washed down and in a region which was unwashed. It was noted that on the deck of a washdown protected ship the air contribution was 90 percent of the total dose rate and 80 percent of the total dose at the time of maximum fallout, and 25 percent of the total dose at the time that the fallout stopped. The water contribution was virtually insignificant, the dose accumulated was 400 mr up to the time that the YAG-40 left the area.

Interaction of Gamma Radiation with Steel

Gamma fields inside steel cylinders of various thicknesses were compared as a function of cylinder thickness and time. Least square straight lines were drawn for the plots on semilog paper. The slopes of these lines determine combined absorption and multiple scattering coefficients (μ). The indications are that the [redacted] (Zuni) data were significantly different from the Castle data. Instrumentation errors cannot account for all of this difference, leading one to suspect that for later times the [redacted] gamma energy spectrum contained a greater percentage of high energies than was the case at Castle [redacted] (Romeo), [redacted] (Union), and [redacted] (Yankee).

CONCLUSIONS

For surface detonations [redacted] the relative dosage contribution from the contaminated water appeared to be insignificant. The dosage contributed by the contaminated air surrounding a washdown protected ship accounted for most of the dosage which would be received by an exposed person during fallout.

The interaction of the gamma radiation with steel indicated that the [redacted] gamma energy spectrum had a greater percentage of high energies at later times than was true for the Castle shots.

[redacted]

[redacted] (ZUNI)

Project 2.8 - Shipboard Countermeasures Methods Studies - R. H. Heiskell

OBJECTIVE

To determine the relative effectiveness of various proposed ship and personnel protection and reclamation methods.

DESCRIPTION AND EXPERIMENTAL PROCEDURE

These studies consisted of 8 problems to be carried out on the YAG-39 and YAG-40 and at the Rad Safe center on Parry. These 8 problems involved the study of the effectiveness of various shipboard protective methods, decontamination methods, hazard assessment methods, personnel protection and decontamination methods, and basic contaminability-decontaminability.

RESULTS AND CONCLUSIONS

The experimental hot water sensitive paint (RRPC) used in these tests was not satisfactory from a durability and weatherability standpoint, however it was successful from the standpoint of removability and decontaminability. Removal rates varied from 10 square feet per minute using a 1250 gph hot liquid jet unit to approximately 20 square feet per minute using a 6000 gph unit. Prior firehosing removed 87 percent of the contaminant and the stripping of the RRPC removed approximately 85 percent of this residual, for an overall removal of 98 percent. Stripping of the RRPC without firehosing removed 95 percent of the contaminant.

The decontamination effectiveness of the mechanical brush was found to be inferior to manual brushing. The manual scrubbing demanded in this test was very vigorous and after a matter of minutes the men tired.

Contaminated small diameter wire ropes contribute very little to

[redacted]

the radiation field when extended, but in the coiled position they may contribute considerably.

A snythetic resin sealer applied to a canvas material was found to greatly increase the decontaminability of canvas.

It was found that firehose presents no serious radiation hazard when extended, but in the coiled up position the survey readings were higher by a factor of 10 than those taken along the length of the hose.

Wood samples in both washdown and non-washdown areas received considerable contamination. Some samples in the non-washdown area were reading as high as 1200 mr/hr on D + 2. The samples are now being processed by coring and slicing to determine depth of penetration and contaminant distribution.

Additional test surfaces were contaminated on YAG-39 and the decontamination studies are now in process.

[redacted]

[redacted] (ZUNI)

Project 2.9 - Standard Recovery Procedure for Tactical Decontamination of Ships - F. S. Vine

OBJECTIVES

To proof test a ship decontamination procedure consisting of firehosing, handscrubbing with detergent, and a second firehosing, in that order.

To perform an operational decontamination of the YAG-39, YAG-40, and LST 611, as required, to permit participation of these ships in other scheduled shots.

PROCEDURE

On [redacted] (ZUNI) the YAGs and LST were positioned in the predicted fallout area as test platforms for Project 2.6.3. Upon completion of their missions the ships returned to Eniwetok.

Operational decontamination of the YAG-40 was begun on D + 3 and completed on D + 5.

In the forward (non-washdown) section, all surfaces except the face of the superstructure and the experimental areas reserved for Project 2.8, were decontaminated by the firehosing, handscrubbing, firehosing procedure. The high pressure, hot liquid jet was used on the face of the superstructure and for a final cleanup of the experimental areas. The remainder of the superstructure and the after deck house were decontaminated by means of firehosing and handscrubbing. The hot liquid jet was used on all other stern section surfaces.

RESULTS

On the YAG-40 [redacted] the initial level in the non-washdown area forward of the superstructure was 477 mr/hr at the beginning of decontamination. The above-described procedures reduced this to 20 mr/hr, an effectiveness of 92 percent when corrected for decay. In the washdown area, which included the superstructure, the initial level was 115 mr/hr. Following decontamination the level was 13 mr/hr, an effectiveness of 78 percent when corrected for decay. This is in agreement with results obtained in operation CASTLE which showed decreased decontamination effectiveness following washdown.

The working party of 45 men was divided into 5 & 6 man teams and expended a total of approximately 15 working hours in the decontamination of the two ships.

CONCLUSIONS

It is feasible to decontaminate a ship by means of the procedures described herein.

The effectivenesses reported are probably higher than would be obtained in the removal of a more tenacious contaminant.

[redacted]

[redacted] (ZUNI)

Project 2.10 - Verification of Washdown Effectiveness as a Shipboard Radiological Countermeasure - M. M. Biggers

OBJECTIVES

Operation of YAG's and LST to be stationed in fallout area.

Rad Safe support for NRDL projects.

Washdown evaluation.

DESCRIPTION AND EXPERIMENTAL PROCEDURES

This project documents the procedures involved with the deployment and turn-about operations of the YAG's and LST. It also reports on the effectiveness of the washdown systems.

RESULTS

Ship Operations

The project ships, YAG-39, YAG-40, and LST-611, successfully completed their mission [redacted] The ships operated in areas N and NNW of Bikini at ranges of about 40, 80, and 100 miles respectively for the YAG-40, YAG-39, and LST-611.

The YAG-40 encountered fallout at $H + 3$ hours on deck in the non-washdown area. The radiation field on deck in the non-washdown area peaked at about 9 r/hr at $H + 7$ hours. The ship was closed and the washdown was in operation for a period of about 15 hours. On the after part of the ship where the washdown was activated, the dose rates were 15 to 25% of those forward. All operational equipment functioned satisfactorily.

YAG-39 intercepted light fallout at about $H + 10$ hours on D-day. Activity slowly increased to 35 mr/hr at about $H + 18$ hours and held fairly constant at that level until about $H + 28$ hours. The washdown

59

[redacted]

[redacted]

was secured at H + 30 hours and the ship opened at H + 33 hours.

The LST-611 encountered fallout only on D + 1 when at about 0900 (H + 27) a level of about 0.2 mr/hr was obtained. However, the radiation level on the deck was about 10 mr/hr in the puddles remaining after the washdown was secured. This activity probably came from contaminated sea water being pumped through the washdown system when the ship traversed the fallout area.

Washdown Evaluation

Radiation intensity levels aboard YAG-40 appeared to be satisfactory for the purpose of evaluating the washdown system and have been given precedence over those of the YAG-39. It will be some time before the YAG-39 data are available.

The records from two continuous gamma intensity recorder stations forward in the unwashed area have been reduced and compared with similar stations under the washdown. Survey and film pack data are not available at this time for comparison purposes. The gamma stations indicate that at the time the washdown was secured the percent effectiveness was about 85% for dose rates and 82% for total dose accumulated up to that time.

Visual inspection of the YAG-40 upon her return to Eniwetok for decontamination showed the forward half of the ship completely covered by the fallout material, all the decks taking on a coral-white sheen that obscured their usual navy grey color. An appreciable amount of fallout material was observed to have collected under the washed area aft. It appeared to consist of calcium particles about 200 micron average diameter of high enough mass to be effectively held up by such

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[redacted]

obstructions as deck butt joints and the dished deck areas. The particles appeared to have combined upon contact with the salt water, and upon being held up tended to become cemented to the deck and deck appurtenances. This was the first opportunity to observe the washdown against this type of contaminant.

The washdown effectiveness of 82 and 85 percent compares favorably with the results obtained during Operation CASTLE. These values will be adjusted when corrections are available for deducting the dose contributions made by the air envelope during the transit time.

[redacted]

61

[redacted]

[redacted] (ZUNI)

Project 4.1 - Biomedical Effects - Flash Blindness and Chorioretinal Burns - Col R. S. Fixott

OBJECTIVES

To gain information regarding the behavior of lid reflexes under the high illuminations produced by atomic devices; to further evaluate the blink reflexes as a protective mechanism against chorioretinal burns.

To gain information on shutter and filter mechanisms for eye protection against chorioretinal burns caused by atomic weapons of various types and yields.

INSTRUMENTATION

The experimental arrangement for this project required the exposure of animal eyes to the weapon detonation at distances which produced retinal lesions in a similar test series during UPSHOT-KNOTHOLE. Rabbits and monkeys were the animals of choice; the former because of ready availability and limited motility of the eye, the latter because of close resemblance to the human eye. Exposure racks were constructed to render nearly complete protection of the animal from whole body effects, when such protection was indicated. Direct exposure was limited to one eye of subject rabbits. The monkeys had both eyes exposed, being used solely for determining the protection offered by the blink reflex.

Staggered shutters of two types were used. The simple closure shutters were open at time zero and closed at varying intervals after, up to 1 second. The closed-open-closed shutters were closed at time zero, opened at a specified time, remained open for varying durations, then closed.

Prototypes of electromagnetic shutters of two types are being field tested as a part of this program. These shutters are designed to prevent or minimize flash blindness, after-images, or retinal burns. Results obtained on animals exposed behind these shutters will be compared with those obtained by other shutters and filter mechanisms.

None of the animals exposed had eyes held open by artificial means. This introduced the possibility that the eye might be closed at time zero. An alarm bell was set up to waken animals. Cameras focused on the animals were used to determine shutter speed and to ascertain whether eyes were open during the time of exposure.

RESULTS

An examination of the exposed eyes of the animals revealed a minimal chorioretinal burn in a single rabbit. This rabbit was unprotected, except by his own blink reflex. A visual check of the equipment at the time of re-entry indicated that it had functioned properly. Accurate determination of the actual performance of the shutters and of blink reflex time awaits analysis of high speed motion pictures.

Of 81 rabbits and 3 monkeys exposed, 7 rabbits and 2 monkeys were dead at re-entry time.

CONCLUSIONS

The presence of a single chorioretinal injury suggests that the total thermal energy delivered at the exposure site was probably somewhat less than had been calculated, and was quite certainly delivered at a much slower rate. The normal blink reflex time as determined in the laboratory is very nearly coincident with the beginning of the second pulse after detonation. The presence of a single lesion attributable to the flash does not furnish sufficient data to make any evaluation of shutters and filters. Based on these conclusions,

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[redacted]

modification of experimental design is planned for participation in later MT weapon tests. The site will be nearer to ground zero, giving a higher total thermal yield. This should give valuable information, particularly with reference to the eye protection afforded by the blink reflex when animals or persons are exposed to the flash of this weapon in the range of several megaton yield.

[redacted]

[redacted] (ZUNI)

Project 5.1 - In-Flight Participation of a B-47 - C. W. Luchsinger

OBJECTIVE

The objective of this project was to measure the blast, gust and thermal effects of a nuclear detonation on an in-flight B-47 aircraft so that the data recorded could be used to verify and/or correct the criteria and methods used in the B-47 Weapon Delivery Handbook. In addition, the project will provide basic research data for the design criteria of future USAF aircraft.

INSTRUMENTATION

With the installation of new elevators, 301 data channels were available on this shot to record bending, sheer and torsion in the wing and horizontal stabilizer, thermal inputs to the aircraft, thermally induced strain, temperature measurements, and overpressures. Prior to shot participation 96 percent of these channels were operating satisfactorily.

AIRCRAFT POSITION IN SPACE

The B-47 was flying at an absolute altitude of 31,000 feet, a speed of mach .75 and on a heading of 250°T at both T_o and shock arrival. At T_o, the horizontal range beyond ground zero was 31,500 feet, at shock arrival it was approximately 87,200 feet.

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[redacted]

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seconds.

DISCUSSION

The inputs received by the B-47 [redacted] ppear to check with the expected inputs. Thus the results will be useful in fulfilling the objective of the project as well as aiding in verification of positioning methods.

[redacted]

[redacted] ZUNI)

Project 5.2 - In-Flight Participation of a B-52 - Lt F. L. Williams

OBJECTIVE

The objective of this test was to determine the delivery capability of the B-52 aircraft.

INSTRUMENTATION

Instrumentation of the B-52 consisted of 316 oscillograph channels which recorded measurements from strain-gage bridges, accelerometers, thermocouples, pressure tranducers, calorimeters, roll and pitch gyros, radiometers, and control position transducers. In addition, 16 cameras recorded photo-recorder instruments, wing deflection, cloud coverage, and fireball rise and growth.

AIRCRAFT POSITION IN SPACE

The following chart shows the airplane's position at Time Zero and shock arrival:

	Altitude (Absolute)	Offset (ft)	True Heading (degrees)	*Slant Distance (ft)	Velocity (fps) TAS	Ground
Conditions at Time Zero	32,000	5,000	248	39,600	830	790
Conditions at Gust Arrival	32,000	5,000	248	69,900	835	795

*Slant distance from Aircraft to Ground Zero

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67

[redacted]

Instrumentation Failures: Thirteen oscillograph channels failed during the [redacted] mission. All cameras and photo-recorder channels remained operative. Approximately 96.2 percent of the total instrumentation was operative [redacted]

[redacted]

[redacted] (ZUNI)

Project 5.3 - In-Flight Participation of a B-66B - R. W. Bachman

OBJECTIVE

The primary objective of this test was to measure the thermal effects of a large yield nuclear airburst on a B-66B aircraft in-flight.

INSTRUMENTATION

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Instrumentation of the B-66 for [redacted] (Zuni) consisted of 60 thermocouples and 73 strain gages at 7 stations on the left wing, 9 thermocouples and 10 strain gages at 2 stations on the right wing, 34 thermocouples and 18 strain gages at 7 stations on the left stabilizer, and 9 thermocouples and 12 strain gages at 3 stations on the right stabilizer, plus 63 channels of correlating information.

AIRCRAFT POSITION IN SPACE

Using the K-5 Radar System the B-66 was positioned at an altitude of 19,000 feet, a heading of 070 degrees and a horizontal slant range of 27,000 feet at time zero. At time of shock arrival the horizontal range was 98,600 feet with the a/c on the same heading and the same altitude as before.

RESULTS

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69

[redacted]

DELETED

70

[redacted]

[redacted] (ZUNI)

Project 5.4 - In-Flight Participation of a B-57B - Lt Harold M. Wells Jr

OBJECTIVE

The objective of this project is to measure the effects of a nuclear detonation on an in-flight B-57 aircraft. Recorded data will be used to verify or correct the B-57 Weapons Delivery Handbook. In addition, the project will provide basic research data for design criteria of future USAF aircraft.

INSTRUMENTATION

Out of 220 channels being recorded, 8 data channels were lost for various reasons. They have been repaired, or replaced by spares.

Instrumentation consisted of strain gages, thermocouples, calorimeters, radiometers, pressure gages, and various other tranducers. It was planned to position the B-57 in a position corresponding to approximately 80 - 85 percent limit load on the critical member of the aircraft.

AIRCRAFT POSITION IN SPACE

The JB-57B was flying at an absolute altitude of 17,850 feet, heading 073° in a tail-on position at H ≠ 0. Horizontal range to ground zero at H ≠ 0 was 34,000 feet (aircraft traveling at 8.2 ft/sec). Aircraft position at time of shock arrival (H ≠ 79 seconds) has not been received from Raydist. Heading and altitude same at H ≠ 0.

RESULTS

DELETED

[redacted]

71

[redacted]

DELETED

[redacted]

[redacted]

[redacted] (ZUNI)

Project 5.5 - In-Flight Participation of F-84F Aircraft -

Capt R. F. Mitchell

OBJECTIVE

The objective of this project is to determine the response of the F-84F weapon system when exposed during flight to the effects of a nuclear detonation.

INSTRUMENTATION

The instrumentation consisted of strain gage bridges located at Station 90 and 150 on the left and right wing; Station 365 on the fuselage; Flight Station 12 and 35.5 on the left and right stabilizer and W. L. 20 and 53 on the fin. The forementioned strain gage bridges yielded bending moment information. Structure responses were related to energy inputs with overpressure transducers located on a nose boom and in the sides of the fuselage.

AIRCRAFT POSITION IN SPACE

The planned position of Barley was on an inbound heading of 130°T with an offset of 63,600 feet north and east of ground zero. The aircraft was to be directly side-on to the shock wave at H + 51.5 seconds. Actual position on shot day was three minutes late at time zero or approximately 144,000 feet short of the time zero position. Shock arrival occurred at H + 135 seconds instead of H + 51.5 seconds, the calculated value for the on time position. The miss-positioning of the aircraft occurred as a result of an error made by the Raydist Controller.

[redacted]

13

Project 5.7 - Thermal Flux and Albedo Measurements from Aircraft -

Capt R. L. Dresser

OBJECTIVES

The objective of Project 5.7 participation on this shot was to obtain thermal flux and albedo information of a nuclear detonation with airborne calorimeters, radiometers, and sixteen millimeter motion picture cameras.

INSTRUMENTATION

Instrumentation within the purview of Project 5.7 which was installed in the B-47 included nineteen NRDL calorimeters and two NRDL radiometers for measuring the direct and surface reflected thermal radiation. Six calorimeters were utilized to measure thermal radiation which was back-scattered toward the cockpit. Seven GSAP N-9 cameras were utilized to obtain photographic coverage of the fireball, the earth's surface, and of clouds beneath the aircraft, and also of any reflecting surface such as a cloud which could contribute to the back-scattered radiation.

Project 5.7 instrumentation on the B-52 included the basic 21 instruments for thermal radiation measurements, but only an additional two instruments were utilized for back-scatter measurements. Eight GSAP cameras were installed for photographic coverage.

Project 5.7 instrumentation on the B-57 consisted of the basic twenty one instruments and six cameras.

Project 5.7 instrumentation on the B-66 consisted of the basic twenty one instruments and twelve cameras.

Neither tactical bomber (B-66, B-57) was instrumented for measuring

[redacted]

back-scattered thermal radiation. The twenty one basic thermal instruments possessed various fields of view and were suitably filtered to obtain qualitative spectral distribution information. All channels were recorded on Consolidated Recorders except the six back-scatter channels in the B-47 which were recorded on the magnetic tape. The cameras were equipped with red and blue filters to obtain information at each end of the visible region of the spectrum. Several cameras were equipped with spectroscopic attachments to obtain continuous spectra in the visible region. Two of these spectrographs were operated at the EG&G Chiecrete (William) photo tower.

AIRCRAFT POSITION IN SPACE

Information of the position in space of each aircraft is contained in the reports of the following projects:

Project 5.1 - B-47	Project 5.3 - B-66
Project 5.2 - B-52	Project 5.4 - B-57

RESULTS

DELETED

[redacted]

[redacted]

Photographic data

A total of 35 cameras were operated by Project 5.7 on this event. Thirty three of these were airborne in four aircraft. Of these, only one suffered film breakage. All others operated satisfactorily. Of the two cameras operated in the EG&G photo tower at Chieerete, one camera malfunctioned apparently due to thermal damage, and the film of the other was damaged by fallout radiation. An examination of all of the developed film has not as yet been completed.

[redacted]

Project 5.8 - In-Flight Participation of an A3D-1 Aircraft -

LCDR P. S. Harward

OBJECTIVE

The objective of this test was to investigate the A3D-1 aircraft capability for the delivery of the high yield nuclear weapons by the measurement and correlation of the in-flight effects of a nuclear detonation.

INSTRUMENTATION

Instrumentation of the A3D-1 aircraft consisted of 96 oscillograph recording channels, one photo recorder, four GSAP cameras, and three dosimeters. The data recorded included temperature rise, thermal input, rate of thermal input, overpressure, gust loading, aircraft response, engine response, and gamma radiation.

AIRCRAFT POSITION IN SPACE

The A3D-1 aircraft was flying at an absolute altitude of 28,170 feet, heading 071°T in a tail-on position at H-hour. Slant range to ground zero at H-hour was 42,000 feet (aircraft traveling at 822 ft/sec). Aircraft position at time of shock arrival (H + 81.6 seconds) was 100,400 feet slant range on a heading of 071°T at 27,900 feet absolute altitude.

RESULTS

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[redacted]

78

[redacted]

[redacted] (ZUNI)

Project 6.1 - Accurate Location of Electromagnetic Pulse Source - Dr. E. A. Lewis

OBJECTIVE

To utilize the electromagnetic signal originating from nuclear weapon detonations to determine ground zero of detonation. Secondarily to obtain the yield data that is available in the bomb pulse.

PROCEDURE

Location of ground zero is made by use of an inverse Loran principle. The exact time the bomb pulse is received at various stations is recorded. The exact time difference in receipt of the electromagnetic pulse between two stations will be used to determine a hyperbolic curve which runs through ground zero. The point of intersection of two or more curves determines ground zero.

There are two systems. One of the systems is known as the long base line system and the other, the short base line system. Each system has two sets of stations. The long base line has one set of stations located in the Hawaiian Islands (Midway, Palmyra and Maui) with synchronizing antenna station at Haiku, Maui, and the other set of stations in the States (Harlingen, Texas; Blytheville, Arkansas; Kinross, Michigan, and Rome, New York) with synchronizing antenna station at Cape Fear, North Carolina. The short base lines have one set of stations located in the Hawaiian area (Kona, Hawaii; Papa, Hawaii; and Red Hill, Maui) the other set in California (Pittsburg, Woodland, and Maryville).

RESULTS

Short base line

Hawaii. Kona net all stations received and recorded electromagnetic pulse emanating from bomb detonation.

[redacted]

California

Woodland net all stations received and recorded electromagnetic pulse emanating from bomb detonation.

Long base line

Hawaii. Lahaina net all stations received and recorded electromagnetic pulse emanating from bomb detonation.

Stateside. Harlingen AFB Texas all stations received and recorded electromagnetic pulse emanating from bomb detonation.

Griffiss AFB New York received and recorded electromagnetic pulse emanating from bomb detonation.

CONCLUSION

No conclusion can be made until further information is received from data reduction and interpretation.

[redacted]

FOLDER PAGE 81 IS A DUPLICATE OF PAGE 80 AND HAS BEEN REMOVED FROM THIS FOLDER

[redacted]

[redacted] (ZUNI)

Project 6.3 - Effects of Atomic Explosion on the Ionosphere -

M. A. Hawn

OBJECTIVE

The objective of Project 6.3 is to obtain data on the effects of high yield nuclear explosions on the Ionosphere. Principally, to investigate the area of absorption, probably due to the high altitude radioactive particles, and to study the effect of orientation relative to the earth's magnetic field on F2 layer effects.

INSTRUMENTATION

The system comprises:

Two Ionosphere recorders, type C-2, operating on pulse transmission, installed in 6 ton trailer vans, one located at Rongerik Atoll and one located at Kusaie in the Caroline Islands.

One Ionosphere recorder, type C-3, operating on pulse transmission, installed in a C-97 plane based at Eniwetok Island.

Detailed Description:

Ionosphere recorder site (Rongerik Atoll)

site (Kusaie)

a. AN/CPQ-7, type C-2 Ionosphere recorder with a power output of 10 KW peak pulse alternately transmitting and receiving automatically over the range of frequencies from 1 to 25 megacycles. This equipment measures and records at vertical incidence the virtual height and critical frequencies of ionized regions of the upper atmosphere.

b. A 600 ohm multiple wire antenna designed and erected, so that that the direction of maximum intensity of radiation will be at the

[redacted]

81

[redacted]

desired vertical angle over all of the operating frequency range from 1 to 23 megacycles. The transmitting and receiving antennas and the ground plane were in mutual perpendicular planes with the plane of the transmitting antenna oriented 53° to the east of magnetic north.

<u>Ionosphere recorder site (C-97 airplane)</u>

a. Same as for Rongerik and Kusaie, except that a C-3 Ionosphere recorder was used. This recorder is the same as the C-2, except for a few modifications and improvements.

b. The transmitting antenna in the C-97 was a single wire delta fastened to the lateral extremities of the tail assembly.

<u>OPERATIONAL</u>

Ground stations at Rongerik and Kusaie, using 15 second sweep operated on normal 24 hour schedule: 5 sweeps per hour until H-15 minutes; thence continuous until H + 8 hours; thence routine.

Airborne Station C-97: Routine operation until H-15 minutes; thence continuous using a 30 second sweep time until approximately H + 5 hours.

<u>RESULTS</u>

Ionosphere stations at Kusaie, Rongerik and the C-97 airborne station operated successfully during this test.

Kusaie: The effects observed for this test were about the same as those observed during [redacted] (CHEROKEE) except that the arrival time of the disturbance in the F region was approximately 5 minutes earlier at H + 27 minutes.

Rongerik: The effects were approximately the same as for [redacted] (CHEROKEE).

[redacted]

[redacted]

C-97 airborne station: Recorded data will not be available for evaluation until the plane returns from Hickam AFB.

The Ionosphere was in a slightly disturbed condition (due to abnormal conditions already existing) prior to shot time.

[redacted]

[redacted]

[redacted] .JUNI)

Project 6.4 - Determination of Characteristics of Airborne Flush Mounted Antennas and Photo Tubes for Yield Determination at Extended Ground-to-Air Ranges - Allan J. Waters

OBJECTIVES

To determine the effectiveness of flush mounted airborne antennas and phototubes at various ground-to-air ranges in detecting characteristic low frequency electromagnetic radiation and visible radiation, respectively.

To determine the temporal and amplitude characteristics of the low frequency electromagnetic radiation at various ground-to-air ranges.

To determine the temporal and intensity characteristics of visible radiation at various ground-to-air ranges.

To determine the effects of ambient conditions upon the satisfactory measurement of the parameters specified in the first two items above.

INSTRUMENTATION

2 fiducial antennas	2 scope cameras
1 whip antenna	1 sequence camera
1 synchronizer	1 recorder
2 photoheads	

2 Dumont Scopes (1 a dual beam, 1 a single beam)

RESULTS

Aircraft distance was approximately 92 miles from ground zero. Equipment was functioning properly and was keyed at the proper interval before zero minute. This would lead one to believe that desired data was obtained. As data is instantaneous, results cannot

[redacted]

be confirmed until development of photography.

CONCLUSIONS

Depends on results of photography.

56

[redacted] (ZUNI)

Project 6.5 - Analysis of Electromagnetic Pulse Produced by a Nuclear Explosion - Charles J. Ong

OBJECTIVE

The objective of Project 6.5 is to obtain waveforms of the electromagnetic radiation for all the detonations during Operation REDWING. This data is to be used in connection with a continuing study relating the wave form parameters to the height and yield of the detonation.

INSTRUMENTATION

Two identical stations are used to record data, one at Eniwetok and one at Kwajalein.

The instrumentation consists of a wide-band receiver with separate outputs connected to each of the three oscilloscopes. Mounted on each oscilloscope is a Polariod Land Camera for recording the transient display.

RESULTS

Station A: Eniwetok

The predicted field strength [redacted] was 16.0 volts per meter. The measured field strength [redacted] was 14.4 volts per meter. The general waveform for the 1.0 μ sec/cm sweep was poor but the waveforms recorded for the other two scopes were good.

Station B: Kwajalein

No record data due to the loss of timing with WWVH.

CONCLUSIONS

All data has been forwarded to Evans Signal Laboratory for final analysis.

S

[redacted]

[redacted] (ZUNI)

Project 8.1 - Basic Thermal Radiation Measurements - W. B. Plum

OBJECTIVE

The objective of this project was to measure the time history of irradiance, thermal radiant energy, and the spectral distribution of radiant energy from three stations with a time resolution of 20 msec; and the irradiance and spectral distribution of irradiance from two stations with a time resolution of 50 microseconds. From these data it will be possible to obtain a general transmission coefficient for the atmosphere, transmission coefficients for the atmosphere for narrow wavelength bands, scattering coefficients as a function of the field of view, and the partition of energy between the first and second thermal pulses.

INSTRUMENTATION

Three stations were instrumented for this shot. Station 812.01 on Chieerete, 32,077 ft from GZ; Station 810.03 on Airukiiji, 16,900 ft from GZ; and Stations 813.01A at the 200 ft level on Enyu and Station 813.01B on top of the instrument trailer, 68,700 ft from GZ. NRDL radiometers and calorimeters, listed below, were used on this shot. Duplicate instruments consisting of 11 calorimeters and 1 radiometer were connected to each Heiland oscillographic recorder. Two recorders were used at each station.

(1) Total energy, quartz filter, 90 degree field of view

(2) Total energy, quartz filter, 90 degree field of view

(3) Spectral, 3-69 filter, 90 degree field of view

(4) Spectral, 2-58 filter, 90 degree field of view

(5) Spectral, RG-8 filter, 90 degree field of view

[redacted]

(6) Spectral, 7-56 filter, 90 degree field of view

(7) Field of view, quartz filter, 11 degree field of view

(8) Field of view, quartz filter, 22 degree field of view

(9) Field of view, quartz filter, 45 degree field of view

(10) Field of view, quartz filter, 90 degree field of view

(11) Field of view, quartz filter, 160 degree field of view

(12) Radiometer, quartz filter, 90 degree field of view

The NRDL recording spectrometer was used at Stations 813.01A and 813.01B. This spectrometer was used to measure the spectral distribution of irradiance as a function of time with a time resolution of 50 microseconds.

The NRL bolometer was used to measure the irradiance as a function of time with a time resolution of 50 microseconds. Two bolometer channels were located at each of the Stations, 813.01A and 813.01B on Enyu.

RESULTS

All instruments functioned satisfactorily with the exception of three of the 15 cameras. A preliminary reduction of the data without the aid of precision instruments gives the following results:

Station	Quantity Measured	Quantity
812.01	Total Energy	21.2 ± 3.0 cal/cm^2
812.01	Max Irradiance	7.4 ± 1.0 $cal/cm^2/sec$
812.01	Time to Max Irradiance	1.95 seconds
810.03	Data not reduced for preliminary report	
813.01A	Total Energy	1.6 ± 0.3 cal/cm^2
813.01A	Max Irradiance	0.9 ± 0.13 $cal/cm^2/sec$
813.01A	Time of Max Irradiance	1.73 seconds

[redacted]

Station	Quantity Measured	Quantity
813.01B	Total Energy	1.3 $\pm$ 0.2 cal/cm^2
813.01B	Max Irradiance	0.66 $\pm$ 0.10 cal/cm^2/sec
813.01B	Time of Max Irradiance	1.75 seconds
813.01B (Bolometer)	Time of First Max	2.5 msec
813.01B "	Time of Minimum	160 msec
813.01B "	Time of Second Max	2.0 sec

Only 0.05 percent of the total thermal energy was received prior to the minimum.

90

[redacted]

[redacted]

[redacted] (ZUNI)

Project 8.5 - Airborne High Resolution Spectral Analysis -

Dr. Ralph Zirkind

OBJECTIVE

To determine the spectral distribution of the irradiance from a megaton surface burst at an airborne station and compare it with an identical measurement from a surface station; and to determine the fireball color temperature by correcting for atmospheric attenuation by an independent measurement.

INSTRUMENTATION

The spectral distribution of irradiance is obtained from a medium quartz Hilger spectrometer. The spectrum is sampled in narrow bands by photocells in the visible region and PbS cells in the infrared. The electrical signal is then recorded on an Ampex 814 tape recorder, with a resolution time of 150 msec. The transmission measurement is accomplished by beaming a pulsed light signal of known output and spectral distribution from a fixed point on the ground towards the aircraft. The attenuated beam is received by a detector in the aircraft and recorded on a Heiland recorder. The detector consists of two filtered photomultiplier tubes sampling two spectral regions, (1) 0.3-0.55 microns and (2) 0.6-1.05 microns. In addition, a quartz filtered calorimeter, 22 degrees field of view, is utilized to measure the approximate radiant exposure received at the spectrometer.

RESULTS

The aircraft was located at the intended position (22,000 feet absolute, with a horizontal range of 63,400 feet in a tail-on position) at T_0.

[redacted]

91

[redacted]

[redacted]

The spectrometer operated normally and to date data appears on all channels from 3 to 13. Note: Channels 1 and 2 are in the 2500 - 3000 Angstrom region.

The calorimeter functioned and satisfactory data was obtained.

The Transmission measurement was not performed due to insufficent time available to repair light which, during a test run on D-2, malfunctioned. Simulated runs will be made to obtain a statistical sample of the atmospheric atteruation existing for this event.

[redacted]

[redacted] (ZUNI)

Project 9.1 - Technical Photography - Lt Col Jack G. James

Project 9.1 aircraft RB-50 CARTER 1, 2, and 3 participated on this event. All three aircraft were properly positioned at zero time. The first 15 minute leg of cloud photography was flown at 20,000 feet. CARTER 1, climbed to 25,000 feet on the back leg and completed the mission at this altitude. CARTER 2 and 3 maintained a 20,000 feet altitude with an unrestricted view of the nuclear cloud. Photography covered cloud growth and drift for approximately one hour. Camera crews reported no malfunctions. In addition to camera work each aircraft carried a bhangmeter mounted in starboard oblique camera window.

At conclusion of the cloud photography mission, CARTER 1 proceeded to ground zero and was cleared into the area at 0830 for the purpose of aerial mapping the crater and perform damage assessment photography. Low clouds prevented flying the crater survey at the prescribed altitude of 3,000 feet. However one photography run was made over ground zero at 1,500 feet in an effort to record preliminary data on crater radius. This film has been analyzed and results were satisfactory. True crater measurements will be accomplished as soon as weather conditions permit.

93

[redacted]

PART III

TASK UNIT 1

LASL PROGRAMS

Keith Boyer

Keith Boyer
Advisory Group

Program 16 -	Physics & Electronics & Reaction History	B. E. Watt
Program 18 -	Thermal Radiation	H. Hoerlin

[redacted]

94

[redacted]

[redacted] (ZUNI)

Project 16.3 - Electromagnetic Investigations - R. Partridge

[redacted]

95

[redacted]

[redacted] (ZUNI)

Project 18.3 - Spectroscopy - H. Stewart

For purposes of intercomparison all results obtained by Project 18.3 are presented and discussed in the Navajo report where a description of instrumentation is also included.

On the [redacted] (Zuni) Shot all equipments operated. There was insufficient light to give exposures on the 102 spectrographs, the U of R spectrograph and the 70 mm strip spectrograph. Faint pictures of Teller light and fireball growth were obtained on the Bowen and the Mod 6. A faint Teller spectrum appeared on the Meinel plate. A good minimum exposure was obtained with the Jaco.

[redacted]

[redacted] (ZUNI)

Project 18.4 - CHORD EXPERIMENT - H. Hoerlin

TIME INTERVAL MEASUREMENT

E. W. Bennet, R. Day, Don Westervelt

[redacted]

9

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It should be stated that the equipment used for these measurements was not designed for this purpose, but rather for spectroscopic analysis of fireball phenomena.

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100

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[redacted]

Fig. 18.4-1

[redacted]

101

PART IV

TASK UNIT II

UCRL PROGRAMS

W. D. Gibbins
W. D. Gibbins
Dep for UCRL

Program 21 - Radiochemistry	R. H. Goeckermann
Program 22 - History of the Reaction	L. F. Wouters
Program 23 - Scientific Photography	H. B. Keller

102

[redacted]

[redacted] (ZUNI)

Project 21.1 - Radiochemical Analysis - R. Goeckermann

103

[redacted]

[redacted] (ZUNI)

Project 21.2 - Sampling - R. Batzel

The Air Force Special Weapons Center supplied two F-84G and three B-57 to take samples on this device.

10

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[redacted]

[redacted] (ZUNI)

Project 22.1 - Measurement of Alpha and Timing - W. H. McMaster

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

110

1-11592.

[redacted]

Fig. 22.1-2

[redacted]

113

Project 23.1 - Fireball and Bhangmeter - H. Grier

D. F. Seacord B. M. Carder

FIREBALL

A total of four Eastmans, one 35mm Fastax and one Mitchell from Enyu, Aomoen, and Chieerete [redacted] There was no significant change in yield as seen from the three stations.

Meteorological data were not available at the time of analysis to employ the variable ambient density correction; consequently, an average density value based on past observations was used. The variation in yield due to density will not result in a significant yield change.

[redacted]

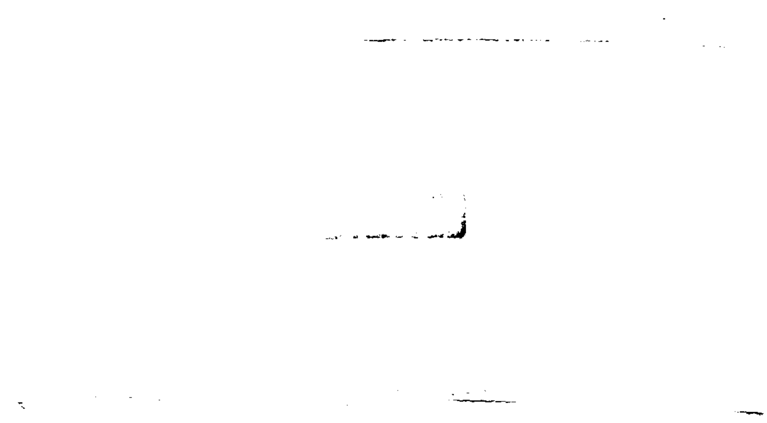

Fig. 23.1-1

[redacted]

[redacted]

Fig. 23.1-2

[redacted]

[redacted]

[redacted] (ZUNI)

Project 23.2 - Cloud Photography - H. E. Grier

Preliminary measurement of height-to-top and maximum diameter at time of stabilization have been made on two 70mm Airborne Cloud camera films. The distance of the aircraft was determined from the Navigator's log and is approximate at this time.

The results were:

Height-to-top

RB-50 #7120	90,000 feet
RB-50 #47131	88,000 feet

Diameter at stabilization

RB-50 #7120	73,000 feet
RB-50 #47131	80,000 feet

The time of stabilization can only be approximated at this time because the cameras failed to record the zero frame. The approximate time is 05:58.81.

[redacted]

[redacted]

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Fig. 23.2-1

[redacted]

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[redacted]

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[redacted]

[redacted] (ZUNI)

Project 23.5 - Remote Time Measurements - H. E. Grier

B. M. Carder

One record was obtained from two streak cameras operating at the Enyu control point.

DISTRIBUTION:

Copy 1A - CJTF SEVEN (B. H. Hanlon)

2A - DCSM, JTF SEVEN (W. E. Ogle)

3A - CTG 7.1 (G. L. Felt)

4A - D/UCRL, TG 7.1 (G. W. Johnson)

5A - D/DOD, TG 7.1 (L. L. Woodward)

6-7A - DMA, USAEC (A. D. Starbird)

8-9A - Chief AFSWP (A. R. Ludecke)

10-14A - Report Library, LASL

15-19A - UCRL, (H. York)

20-24A - Field Command, AFSWP (F. O'Beirne)

25-29A - Sandia Corp (R. A. Bice)

30A - ALOO, USAEC (J. E. Reeves)

Zuni

Project 18.3, 1 page issued as a separate report (JC-234)

Distribution:
Copies 1,2,3,&4A - Hoerlin

Zuni

Project 18.4, 5 pages issued as a separate report (JO-235)

Distribution:
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